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Yield Response of Maize (*Zea mays* L.) Cultivars under Rainfed Condition

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Abstract

A field experiment was carried out during *kharif* season of 2013 at Agronomy Research farm, SASRD, Nagaland University, Medziphema under rainfed condition to study the performance of different maize cultivars. The experiment was laid out in RBD. The treatments of the experiment were comprised of ten maize cultivars viz, DHM-117 (Hybrid), Vijay (Composite), RCM-75 (Composite), RCM-76 (Composite), DA.61-A (Composite), Epok Tsungaro (Local), Elong Tsungaro (Local), Ekyuv Tsungaro (Local), Mhapho (Local) and Mengya (Local). The results of the experiment revealed that cultivar RCM-76 was the fastest growing among all the maize cultivars tested which recorded the tallest plant height, maximum number of green leaves plant^{-1}, highest stem thickness, highest leaf are index, highest crop growth rate and maximum shoot dry weight. The same cultivar was also found to obtain maximum value of yield attributing characters viz., No. of cobs plant^{-1}, cob diameter, cob length and test weight and ultimately produced the highest grain yield (5576.72 kg ha^{-1}) along with highest stover yield (8856.67 kg ha^{-1}). Highest gross return (₹ 83651 ha^{-1}), net return (₹ 58311 ha^{-1}) and benefit cost ratio (2.3) was recorded with RCM-76 which was followed by DHM-117 with benefit cost ratio of 2.1. Among all the tested cultivars, local cultivar Epok Tsungaro obtained lowest value in growth and yield attributes and produced the lowest grain yield (1293.65 kg ha^{-1}) which gave negative benefit cost ratio of -0.2.

Keywords: Maize, hybrids, composites, yield

1. Introduction

Maize is the most productive cereal which is characterised by a genetic diversity. The north- eastern hill region of India owing to their favourable agro-climatic condition has great potential for the cultivation of maize. Among the north-eastern states, the climatic condition in Nagaland are conducive for the cultivation of maize and it is one of the principal crops which is grown under *jhum* or shifting cultivation. A large number of local maize cultivars are grown in the state which varies in their internal and external characters. Despite the introduction of hybrids or composites which give higher yields, local maize cultivars are widely cultivated in the state. The main reason behind this is unlike the hybrids and composites, local cultivars do not need to be replaced every year and other reason is the easy availability of local ones. A comparison of realised and potential yields of maize in north-eastern hill region indicates that despite wide variations in abiotic and biotic stresses, there is great potential of increasing maize production in this region by using improved varieties. However, a suitable cultivar is the first and foremost requirement for improvement of maize yield for a particular place as the performance of the cultivars varies from place to place due to varied agro-climatic conditions. The growth and yield does not remain the same for all the regions. At the same time, there is a wide gap in the state production as compared to the national production of maize. Hence, it is important to find out the best cultivar suited for the prevailing situation to increase the production.

2. Materials and Methods

A field experiment was conducted during the *kharif* season of 2013 at the experimental farm of the department of Agronomy, School of Agricultural Sciences and Rural Development, Medziphema (25°N, 95°E) to study the performance of different maize cultivars in the region with improved management practices. The experiment was laid out in a randomised block design with 10 treatments replicated thrice. Ten cultivars of maize were selected for comparison which was designated as V_1-DHM-117 (Hybrid), V_2-Vijay (Composite), V_3-RCM-75 (Composite), V_4-RCM-76 (Composite), V_5-DA.61-A (Composite), V_6-Epok Tsungaro (Local), V_7- Elong Tsungaro (Local), V_8-Ekyuv Tsungaro (Local), V_9-Mhapho (Local) and V_{10}-Mengya (Local). The duration of the varieties V_1, V_2, V_3, V_4 and V_5 were 90 days, V_6, V_7 and V_8 were 105 days and V_9 and V_{10} were 111 days.

The experiment was conducted on well drained sandy loam soil having pH-4.2, Organic carbon 0.34%, available

nitrogen-351.22 kg ha^{-1}, available phosphorus-16.33 kg ha^{-1} and available potassium-833.28 kg ha^{-1}. Decomposed FYM @ 10 ha^{-1} was applied one week before sowing. NPK were applied @ 100:60:40 kg ha^{-1} through urea, SSP & MOP respectively. Half N and full doses of P and K were applied as basal dose at sowing time and the remaining half dose of N was applied in two equal splits, one-fourth of total N at knee high stage and the rest at tasseling stage of the crop by top dressing. The spacing of the crop was kept 60 cm row to row and 25 cm plant to plant. The seed was sown at 5cm depth. The maximum and minimum temperature during the growing period (May to September) was found in the month of June and May recording 35.4 °C and 17.6 °C respectively. The highest rainfall was recorded during the month of August with 415.6 mm.

The data were analysed statiscally by applying the techniques of variance and the significant of different source of variations was tested by F-test (Cochran and Cox, 1957).

3. Results and Discussion

From Table 1, it is clear that there was significant variation in plant height among all the maize cultivars. The significant effect may be due to the high responsiveness of hybrid and composite cultivars to the different available growth factors, viz, nutrient, solar radiation and moisture. RCM-76 recorded the highest plant height at all the growth stages. This phenomenon may be attributed towards the higher response of the cultivar to growth factors. Epok Tsungaro recorded the lowest plant height at all the stages. The findings are in agreement with Camacho et al., 1995 and Vinay et al., 1996, who found significant difference in the plant height of different varieties of maize. There was significant variation in stem thickness at all the growth stages of maize cultivars (Table 1). Tariq et al., 2014 also opined that due to genetic variations different maize hybrids showed significant difference regarding stem thickness in maize. The highest stem thickness (1.83 cm) was recorded in RCM-76 at 30 DAS and the lowest stem thickness (1.13 cm) was recorded in Epok Tsungaro and Mengya. At 60 DAS and maturity, the highest stem thickness was recorded in DHM-117 followed by RCM-76 which was statistically at par with each other. There was also significant variation in the leaf area index of the maize cultivars at 30 DAS which may be due to the difference in genetic makeup of the cultivars. Valadabadi and Farahani (2010) reported that leaf area is influenced not only by plant population, climate and soil fertility but also largely due to genotype. However, it was observed that at 60 DAS till maturity, there was no significant variation in the leaf area index (Table 1). At 30 DAS, cultivar Ekyuv Tsungaro recorded significantly highest leaf area index and cultivar DA.61-A recorded the lowest value. At maturity, leaf area index of all the cultivars decreased due to the fact that at these stages, many of the leaves had dried and fallen. These findings are in agreement with Yunusa and Gworgwor, 1991; Camacho et al., 1995, who reported no significant differences in leaf area index of different maize varieties at maturity. The data in Table 2 revealed that there was significant variation in CGR among the maize cultivars. At 30 DAS, the highest CGR (1.86) was recorded in RCM-76 and the lowest CGR (0.79) was recorded in Mengya. At 60 DAS, the highest CGR (2.08) was recorded in Vijay and the lowest (0.53) was recorded in Mengya. There was significant difference in the dry weight of shoot of different maize cultivars (Table 2). DHM-117 recorded the highest at 30 DAS (11.05) whereas RCM-76 recorded the highest at 60 DAS. Epok Tsungaro recorded the lowest dry weight at all stages. This result is in conformity with the findings of Guang et al., 2003 who reported that dry weight of shoot increased as seedling growth progressed. There was significant difference

Table 1: Plant height, stem thickness and leaf area index of different maize cultivars

Cultivars	Plant height (cm)			Stem thickness (cm)			Leaf area index		
	30 DAS	60 DAS	Maturity	30 DAS	60 DAS	Maturity	30 DAS	60 DAS	Maturity
V_1: DHM-117	72.47	292.27	301.89	1.70	2.03	1.99	0.78	1.63	1.36
V_2: Vijay	54.47	217.80	280.77	1.36	1.85	1.77	0.96	2.00	0.93
V_3: RCM-75	67.27	299.27	299.90	1.68	1.85	1.79	0.68	1.42	1.18
V_4: RCM-76	76.47	305.20	305.87	1.83	1.88	1.81	0.73	1.43	1.16
V_5: DA.61-A	70.27	284.80	285.63	1.65	1.77	1.69	0.55	1.08	1.06
V_6: Epok Tsungaro	28.27	131.53	224.97	1.13	1.41	1.31	0.73	1.45	1.01
V_7: Elong Tsungaro	45.33	193.40	273.47	1.31	1.65	1.53	0.76	1.49	0.99
V_8: Ekyuv Tsungaro	36.33	210.20	277.81	1.41	1.73	1.63	1.64	2.55	1.31
V_9: Mhapho	36.80	166.95	260.26	1.23	1.56	1.45	0.72	1.50	1.24
V_{10}: Mengya	34.27	160.73	230.91	1.13	1.51	1.39	0.92	1.80	1.61
SEm±	3.71	14.66	15.19	0.11	0.09	0.09	0.16	0.36	0.19
CD (p=0.05)	11.02	43.55	45.14	0.32	0.28	0.26	0.47	NS	NS

Table 2: Crop growth rate, shoot dry weight no. of cobs plant^{-1}, cob diameter, cob length and test weight of different maize cultivars

Cultivars	CGR (g day^{-1})		Shoot dry weight (g)		No. of cobs plant^{-1}	Cob diameter(cm)	Cob length (cm)	Test weight (g)
	30–60 DAS	60 DAS-Maturity	30 DAS	60 DAS				
V_1: DHM-117	1.74	2.01	11.05	63.18	1.27	3.92	18.58	259.33
V_2: Vijay	1.50	2.08	9.00	54.15	1.07	3.79	14.94	237.00
V_3: RCM-75	1.69	2.03	9.37	60.14	1.13	3.91	17.97	266.00
V_4: RCM-76	1.86	2.02	9.65	65.49	1.40	4.21	18.61	305.33
V_5: DA.61-A	1.62	2.04	9.12	57.59	1.13	3.83	15.24	254.00
V_6: Epok Tsungaro	0.86	0.56	2.63	28.41	1.03	2.61	11.14	139.00
V_7: Elong Tsungaro	0.80	0.74	7.82	31.74	1.07	3.63	12.89	206.67
V_8: Ekyuv Tsungaro	1.20	0.82	7.75	43.81	1.07	3.74	14.51	212.00
V_9: Mhapho	0.80	0.73	5.55	29.53	1.07	3.54	12.61	187.33
V_{10}: Mengya	0.79	0.53	5.82	29.64	1.07	3.43	12.08	157.33
SEm±	0.08	0.16	0.62	2.46	0.07	0.13	0.76	16.17
CD (*p*=0.05)	0.25	0.48	1.84	7.31	0.22	0.38	2.27	48.04

in the number of cobs plant^{-1} where RCM-76 recorded the highest number of cobs plant^{-1} (1.40) and the lowest number of cobs plant^{-1} (1.03) was recorded in Epok Tsungaro. The present findings are in accordance with Vinay et al., 1996 who recorded difference in number of cobs plant^{-1} among different varieties of maize. Among the cultivars, RCM-76 recorded the highest cob diameter (4.21 cm) as well as the length (18.61 cm). Singh et al., 2009 also reported significant differences in cob length of different maize varieties. Significant differences were observed in the test weight among all the maize cultivars (Table 2). The highest test weight was recorded in RCM-76 (V_4) with 305.33 g. The result is in conformity with the findings of Magashi etal., 2015 who reported a test weight varying from 322.32-350.39 g. RCM-76 recorded the highest stover yield while Mhapho recorded the lowest stover yield (Table 3). The variation in stover yield was due to varietal differences as reported by Tolera et al., 1999. The different cultivars of maize showed significant variation in grain yield (Table 3). RCM-76 recorded the highest grain yield with 5576.72 kg ha^{-1} while Epok Tsungaro recorded the lowest yield (1293.65 kg ha^{-1}). The variation in all the parameters between the genotypes may be because of genetic behavior of the genotypes tested. Carrillo et al., 2005 also gave similar opinion. Hence among all the tested cultivars of maize, RCM-76 was found to be the highest yielding maize in the area. This result is in conformity with the findings of Witcombe et al., 2003 who reported that improved variety GM-6 yielded more than the local land races due to the early maturing character of GM-6 suited to the area. The high yields of the improved varieties may be due to their genetic background in adaptation to changing favourable conditions. Local cultivars are mostly location specific and their poor yield performance may be attributed to their unsuitability in the prevailing agro-climatic condition. This can be supported by

Table 3: Stover yield, grain yield and economics of different maize cultivars

Cultivars	Stover yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Gross return (₹)	Net return (₹)	B:C ratio
V_1	8823.00	5271.16	79067	53727	2.1
V_2	6910.00	4063.49	609552	35612	1.4
V_3	8511.33	4973.55	74603	49263	1.9
V_4	8856.67	5576.72	83651	58311	2.3
V_5	7763.00	4474.87	67123	41783	1.6
V_6	4663.33	1293.65	19405	-5935	-0.2
V_7	5653.00	3108.47	46627	21287	0.8
V_8	6769.33	3915.34	58730	33390	1.3
V_9	4312.00	2123.02	31845	6505	0.3
V_{10}	4522.67	1858.47	27877	2537	0.1
SEm±	712.57	438.70			
CD (*p*=0.05)	2117.15	1303.45			

the findings of Lata et al., 2010 who conducted a study on 15 genotypes at three locations covering different agro-climatic conditions. The highest gross return (₹ 83,651 ha^{-1}) and net return (₹ 58,311 ha^{-1}) was recorded in RCM-76 (2.3) which could be attributed to its higher yield.

4. Conclusion

Cultivar RCM-76 showed the best response to growth as well as yield followed by DHM-117 under the rainfed condition of

Nagaland which ultimately gave the most profitable return with a benefit cost ratio of 2.3.

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